PREDICTION OF SMARTPHONE ADDICTION USING ENSEMBLE ALGORITHM

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Abstract

The pervasive issue of smartphone addiction, notably among students and professionals, has become a significant societal concern, impacting daily productivity and mental well-being. This research outlines the development of a predictive machine learning framework to ascertain the likelihood of smartphone addiction using behavioral and demographic data from 500 participants. The study leveraged both traditional algorithms like the Support Vector Classifier (SVC) and Naive Bayes (NB), and advanced models including AdaBoost, XGBoost, Decision Trees, and Stacking Classifiers. The classification was binary, distinguishing individuals as either "Addicted" or "Not Addicted." Key behaviors analyzed included usage in social interactions, dependency during uncomfortable moments, and checking habits in solitude.

Keywords: Smartphone Addiction,Machine Learning Prediction,Behavioral Indicators,XGBoost,Stacking Classifiers,SVC,NaiveBayes,AddictionInterventions,Predictive Analytics,Mental Health

I. INTRODUCTION

Smartphone addiction is becoming an urgent concern, highlighted by mental health experts, educators, and scholars alike due to the extensive integration of these devices in daily activities. This addiction, marked by the excessive and uncontrollable use of mobile devices, can severely impact mental health, reduce productivity, and degrade social interactions. It is often associated with various psychological and behavioral disorders, including anxiety, depression, and sleep disruptions, especially among youths such as students and working professionals.Smartphones, while beneficial for communication, information retrieval, and entertainment, are also a source of concern due to their potential to foster addictive behaviors. Given the rising prevalence of smartphone addiction, there is a pressing need for effective tools to predict and manage it. This research focuses on developing a machine learning framework that identifies potential addiction based on behavioral and demographic factors. This model utilizes data from a detailed survey of 5000 individuals that covers smartphone usage, demographic details, and psychological tendencies.

A .OBJECTIVE OF THE STUDY

The essential objective of this examination is to lay out a far reaching AI structure equipped for distinguishing cell phone habit through the investigation of conduct and segment information. Utilizing a diverse array of machine learning techniques, this study will employ traditional models like Support Vector Classifier (SVC) and Naive Bayes (NB), as well as advanced approaches such as AdaBoost, XGBoost, and Stacking Classifiers. The predictive model developed will classify a sample of 5000 individuals into two categories: "Addicted" and "Not Addicted," based on significant predictors captured in behavioral and demographic variables.

B. SCOPE OF THE STUDY

These individuals were chosen through a survey that gathered comprehensive data on their smartphone usage habits, demographic details, and behavioral signs of addiction. The behavioral data encompasses the frequency of smartphone use in social situations, reliance on smartphones during uncomfortable moments, and the regularity of checking their devices when alone.

C. PROBLEM STATEMENT

Smartphone addiction has become a significant concern in today's society, affecting both students and professionals as they integrate mobile devices deeply into their daily activities. This addiction manifests through excessive and uncontrollable use of smartphones, which significantly impacts productivity, mental wellness, and interpersonal relationships.

II. LITERATURE SURVEY

The phenomenon of smartphone addiction has received considerable attention due to its[1] impact on various demographics, including students and professionals. Research has primarily concentrated on understanding the behavioral patterns, usage tendencies, and psychological effects associated with excessive smartphone[2] use. Key behavioral indicators of addiction include persistent device checking, compulsive usage during free moments, and reliance on smartphones for social engagement[3], mood regulation, and leisure activities. Many investigations have employed behavioral surveys and self-report mechanisms to link specific usage patterns[4] to addiction severity, often classifying individuals by their engagement levels with devices.In the realm of machine learning, an array of models has been implemented to analyze and predict smartphone addiction. Techniques such[5] as Support Vector Classifiers (SVC) and Naive Bayes (NB) are prevalent due to their capacity to manage large, complex datasets and effectively categorize individuals into groups such as "Addicted" or "Not Addicted." However[6], these models sometimes face limitations due to their basic assumptions, like the linear separability expected by SVC or the conditional independence assumed by Naive Bayes.Recent advances have introduced[7] more sophisticated machine learning methods like ensemble techniques and deep learning to tackle smartphone addiction. Notably, models like AdaBoost, XGBoost, and Decision Trees have gained traction for their ability to deal with non-linear data interactions and feature complexities. Decision Trees[8]offer the advantage of transparency but are prone to overfitting, prompting a shift towards ensemble methods that amalgamate multiple model outputs to enhance reliability and accuracy.Stacking Classifiers represent a sophisticated [9]ensemble technique that integrates various models through a meta-model, such as logistic regression or a support vector machine. Behavioral metrics like frequent[10] phone checking, extensive social media use, and smartphone reliance during social or solitary situations are critical for developing predictive models. These behaviors provide insights into the psychological[11] dependency on smartphones, critical for creating accurate addiction prediction models. Moreover, demographic factors like age, gender, and occupation also play a role in addiction likelihood, enhancing model personalization and accuracy. [12] concerns, particularly regarding privacy and data security.

III. PROPOSED SYSTEM

The proposed framework expects to improve the precision and power of foreseeing cell phone dependence through the joining of cutting edge gathering methods and choice tree-based models.At the heartof this system lies AdaBoost, or Adaptive Boosting. This method improves the model's effectiveness by combining several weak learners—basic models with limited prediction capabilities—into a powerful classifier. By iteratively correcting the mistakes of previous models, AdaBoost increases accuracy and prevents overfitting[17], making it crucial for refining decision-making processes.

A. Loading Dataset

The initial step in developing a machine learning model to predict smartphone addiction involves assembling and preprocessing a comprehensive dataset containing behavioral and demographic details of 5000 participants. This dataset integrates variables related to smartphone use patterns and demographic characteristics.

B. Preprocessing

In the study examining smartphone addiction, preprocessing the dataset was crucial for ensuring accurate model predictions. This dataset consisted of behavioral and demographic information from 5000 participants, detailing their smartphone use, social habits, emotional reliance on devices, and solitary usage patterns.

C. Model Training and Classification

The study explored the utilization of machine learning to forecast smartphone addiction by analyzing behavioral and demographic data from 500 participants. This data, which includes usage habits and personal demographics, serves to categorize individuals into "Addicted" or "Not Addicted" groups.

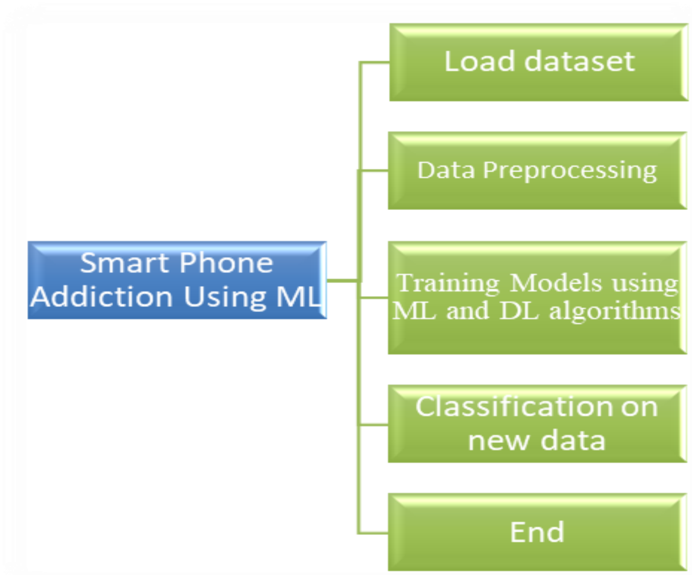

Fig 1: Block Flow Chart of SmartPhone Addiction

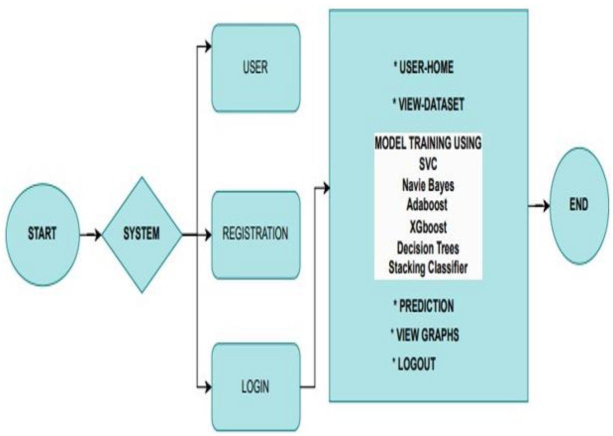

Fig 2: System Architecture of smartphone addiction

IV. METHODOLOGY

SUPPORT VECTOR MACHINE:

Objective: The administered learning calculation Backing Vector Machine (SVM) is commonly utilized for paired grouping issues.

DECISION TREE CLASSIFIER:

Objective: A choice tree is a regulated learning method utilized for both characterization and relapse.

Decision Tree Classifier Report				
	precision	recall	f1-score	support
1	0.86	0.8	0.83	80
2	0.8	0.87	0.83	75
accuracy	0.83	0.83	0.83	155

Table1: Classification report of Decision Tree Classifier

RANDOM FOREST

Objective: Irregular Timberland is a group learning calculation that joins different choice trees to make a more solid classifier.

	Precision	Recall	F1-Score	Support
1	0.95	0.74	0.83	80
2	0.77	0.96	0.86	75

Table2: Classification report of Random Forest Classifier

XGBOOST CLASSIFIER (EXTREME GRADIENT BOOSTING):

Objective: XGBoost is a high level and productive variety of inclination supporting, intended to limit both predisposition and difference by building serious areas of strength for an of choice trees.

	Precision	Recall	F1-score	Support
0	0.94	0.79	0.86	80
1	0.81	0.95	0.87	75

TABLE3: CLASSIFICATION REPORT OF XGBOOST CLASSIFIER

ADABOOST CLASSIFIER:

Objective:

AdaBoost is a group learning calculation intended to join numerous frail classifiers into a solitary, solid classifier.

	Precision	Recall	F1-Score	Support
0	0.87	0.84	0.85	80
1	0.83	0.87	0.85	75

TABLE4: CLASSIFICATION OF ADABOOST CLASSIFIER

G.STACKING CLASSIFIER:

Objective:

Stacking is a group gaining strategy that consolidates expectations from different models, known as base models, utilizing a meta-model. The primary objective is to work on prescient exactness by utilizing the qualities of different models.

	Precision	Recall	F1-score	Support

0	0.94	0.78	0.85	80
1	0.8	0.95	0.87	75

Table5: Classification Report of Stacking Classifier

Artificial Neural Network:

Data Preparation

The initial step that was continued in the examination of the dataset is the parting of information into preparing informational index and testing informational index.

DEEP NEURAL NETWORK:

Data Preparation

The principal undertaking in the process was the apportioning of the dataset into learning and appraisal areas.

CONVOLUTIONAL NEURAL NETWORK

Data Preparation

The main cycle happened in classifying of the dataset into preparing and testing informational indexes. A 70/30 information split was utilized where generally informational index is utilized 70% for preparing and 30 % for testing.

V. DISCUSSION AND RESULTS

This study highlights the effectiveness of machine learning models in predicting smartphone addiction, with a focus on identifying behavioral indicators linked to addictive behavior. The primary goal was to evaluate the predictive capability of various algorithms, including traditional models like Support Vector Classifier (SVC) and Naive Bayes, as well as more advanced techniques such as AdaBoost, XGBoost, Decision Trees, and Stacking Classifiers. The binary classification task aimed to classify individuals as either "Addicted" or "Not Addicted" based on their smartphone usage patterns.These results suggest that stacking different models can combine their strengths, leading to more reliable predictions in real-world scenarios.In contrast, traditional models like SVC and Naive Bayes, while performing adequately, did not offer the same level of predictive power as the more advanced techniques. SVC, effective in high-dimensional spaces, struggled with the diverse nature of the behavioral data, and Naive Bayes' assumption of feature independence was not valid for this dataset, limiting its performance. The findings of this research emphasize the value of incorporating machine learning for analyzing smartphone addiction, especially in developing targeted interventions. Insights from usage patterns can assist educators, mental health professionals,and policymakers in formulating strategies to address addiction. Future studies may enhance model accuracy by including additional factors such as psychological or environmental data, further improving the model's real-world applicability.

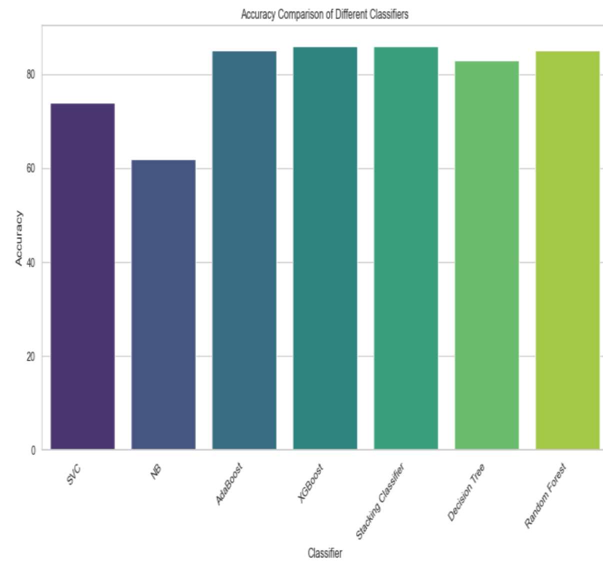

Fig:3 Comparison of Machine Learning Classifiers.

Model	Accuracy	Precision	Recall	F1-score
Support Vector Machine	0.74	0.64	0.94	0.76
Navie Bayes	0.59	0.52	0.76	0.62
DECISION TREE CLASSIFIER	0.83	0.86	0.8	0.83
RANDOM FOREST	0.85	0.95	0.74	0.83
XGBOOST CLASSIFIER (EXTREME GRADIENT BOOSTING)	0.86	0.94	0.79	0.86

Adaboost Classifier	0.85	0.87	0.84	0.85
Stacking Classifier	0.86	0.94	0.78	0.85
Artificial Neural Network	0.67	0.34	0.50	0.40
Deep Neural Network	0.67	0.50	0.40	0.54
Convolutional Neural Network	0.67	0.34	0.50	0.40

Table 6: Comparison table for all the algorithms.

VI. CONCLUSION

This study explores the use of machine learning techniques to predict smartphone addiction, a rising issue among students and professionals. By applying various machine learning models, including traditional algorithms like Support Vector Classifier (SVC) and Naive Bayes (NB), along with advanced methods such as AdaBoost, XGBoost, Decision Trees, and Stacking Classifiers, the research aimed to predict addiction based on behavioral and demographic data from 5000 participants. The binary classification approach successfully categorized individuals as either "Addicted" or "Not Addicted," considering behavioral indicators like social media usage patterns, dependency in uncomfortable situations, and phone-checking frequency when alone. Among the models tested, XGBoost and Stacking Classifiers demonstrated the highest predictive accuracy, highlighting their potential for real-world applications in identifying individuals at risk of addiction. These findings provide valuable insights into the factors driving smartphone dependency and lay the groundwork for future research on intervention methods. Moreover, the study suggests that machine learning could be a powerful tool for mental health professionals, educators, and policymakers in combating smartphone addiction and encouraging healthier usage patterns. With smartphones becoming increasingly integral to daily life, this predictive framework can guide the development of personalized strategies to reduce the negative effects of addiction, ultimately enhancing individual well-being and productivity.

VII. FUTURE ENHANCEMENT

To upgrade the AI model intended for anticipating cell phone fixation, future enhancements can zero in on growing the two the information degree and model intricacy. One vital area of advancement is consolidating more fluctuated datasets that incorporate different segment factors like age, financial foundation, area, and mental characteristics. Also, coordinating information from wearable gadgets like smartwatches or wellness trackers could offer important bits of knowledge into clients' proactive tasks, rest examples, and generally wellbeing — factors that can be impacted by cell phone use.

VIII. REFERENCES

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